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Performance Evaluation of Blockchain Frameworks For Enterprise Software Development

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ABSTRACT
The rapid adoption of blockchain technology in enterprise software systems has necessitated rigorous empirical evaluation of leading frameworks to guide informed deployment decisions. This study conducts a systematic performance evaluation of three prominent enterprise blockchain frameworks Hyperledger Fabric, Enterprise Ethereum, and R3 Corda under realistic enterprise workload conditions. Employing established benchmarking methodologies including the Hyperledger Caliper tool and published empirical datasets, the study operationalizes four critical performance dimensions: transaction throughput, transaction latency, scalability, and resource utilization. Empirical findings reveal that Hyperledger Fabric consistently outperforms competing frameworks, achieving peak throughput of approximately 3,500 transactions per second (TPS) with sub-second latency and maintaining stable scalability across networks exceeding 100 peers at a CPU utilization of just 5.49% and peak memory consumption of 528.23 MB. Enterprise Ethereum, operating under Proof-of-Authority consensus, sustains approximately 200 TPS with latency ranging from 2,000 to 5,000 milliseconds, exhibiting significant performance degradation beyond 16 nodes. R3 Corda delivers competitive bilateral transaction latency of 800–1,000 milliseconds but incurs a throughput reduction of approximately 66% upon notary introduction, constraining its suitability to bilateral financial workflows and small-network deployments. This study contributes empirical guidance to enterprise software engineers navigating the growing landscape of distributed ledger technologies, recommending Hyperledger Fabric for high-throughput mission-critical deployments while positioning Enterprise Ethereum and R3 Corda as viable alternatives within their respective architectural use cases.
Keywords: blockchain performance evaluation, Hyperledger Fabric, enterprise Ethereum, R3 Corda, metrics

1. INTRODUCTION

The rapid advancement of Blockchain technology from its roots in cryptocurrency to a foundational infrastructure for enterprise software systems, has elicit research curiosity. Enterprises increasingly consider blockchain frameworks to enhance transparency, security and trust in distributed business process. Particularly in sector such as finance, supply chain and health care (Gupta & Lakhwani, 2025). By enabling tamper-resistant data storage, decentralized consensus and automated execution of business logic through smart contracts, blockchain platforms have the potential to address the long-standing challenge related to data integrity, interorganizational trust and auditability in enterprise environment.

These features have positioned blockchain as strategic technology for digital transformation initiative across industries.

Yet, despite the profound promises and potentials enumerated above, blockchain adoption at unprecedented scale remained constraint due to performance limitations especially in throughput, latency and scalability, when compared with traditional distributed system and enterprise middleware systems (Kwadzode, 2025; Oliveira et al, 2025). Enterprise applications demand high transaction volumes, fast and predictable time and efficient resource utilization to support mission critical operation. However, the decentralize nature of blockchain coupled the consensus protocols, often introduce computational and communication overhead that hinders performance under high load condition. These challenges have raised concerns regarding the possibility of deploying blockchain solutions in performance sensitive enterprise scenarios.

As a result, performance evaluation has become a critical research domain, aiming to guide practitioners in selecting suitable framework and configuration that meet enterprise performance demands. Performance evaluation in the enterprise context involve systematic benchmarking of key metrics such as transaction per second (TPS), latency, resource utilization, scalability and consensus overhead (Kwadzode, 2025) these metrics provide quantitative insight into how blockchain frameworks behave under realistic workload and enable objective comparisons across different platform with different architectural designs.

Empirical studies have consistently demonstrated that blockchain performance is highly dependent on the type of framework and model of deployment. For example, comparative analysis reveals significant performance variance among prevalent framework; permissioned networks like Hyperledger Fabric often achieve substantially higher throughput and lower transaction cost than it public counterpart like Ethereum under similar experimental conditions (Kwadzode, 2025). This performance advantage is largely attributed to differences in consensus mechanism, identity management and transaction validation model. While public blockchain emphasize decentralization and openness, enterprise oriented permissioned frameworks prioritize efficiency, access control and governance resulting in enhance performance

At the same time, advance performance modeling and experimental evaluations highlight how configuration choices such as: block size, endorsement policies, ordering service design and network scale, influence blockchain responsiveness and resource utilization in enterprise deployment (Melo et al, 2025). These findings suggest enterprise blockchain framework such as Hyperledger Fabric, Ethereum, Corda and Quorum each offer distinct architectural approaches and performance profiles. These frameworks differ significantly in their consensus mechanism, transaction throughput, latency and resource consumption and scalability. Understanding these performances is critical for organization seeking to implement blockchain solution that can meet enterprise grade requirement while maintaining cost effectiveness and operational efficiency.

Despite the emergence of benchmarking tools and evaluation frameworks tailored to enterprise blockchain such as Hyperledger Fabric, Ethereum, Corda and Quorum but the complex interplay between the blockchain design parameters, consensus mechanism, and enterprise workload requirement demand continue empirical investigation (Oliveira et al, 2025). Experience from existing studies reveals that focused has been on isolated performance aspect or controlled experimental environmental, leaving gaps in comprehensive comparative evaluation under realistic enterprise conditions. For example, studies have revealed that existing performance evaluation methodologies often relay on fixed workload load pattern that do not accurately reflect real world deployment scenarios leaving critical unanswered questions about performance under dynamic conditions (Luo et al., 2024)

This study aims to address these gaps by conducting a systematic performance evaluation of leading blockchain frameworks such as Hyperledger Fabric, enterprise Ethereum and R3 Corda within the context of enterprise software development. Using established benchmarking techniques and empirical analysis. The study accesses each framework against critical performance dimensions including throughput, transaction latency, scalability under varying workload and resource consumption. The study will achieve

its set objectives by providing comparative empirical evidence that will provide insights to enterprise software engineer navigating the growing digital landscape of distributed ledger technologies.

1.1 Aim and Objectives

The aim of this study is to comparatively evaluate the performance of leading enterprise blockchain frameworks: Hyperledger Fabric, Enterprise Ethereum and R3 Corda under realistic enterprise workload conditions to provide empirical guidance for enterprise software development.

Research Objectives

1. To evaluate key performance metrics: transaction throughput, transaction latency, scalability and resource utilization as benchmark criteria for enterprise blockchain evaluation.
2. To empirically measure and compare the performance of Hyperledger Fabric, Enterprise Ethereum and R3 Corda under varying workload condition and network configuration.
3. To provide empirical based recommendation to enterprise software engineers on the selection of the right blockchain framework

2. LITERATURE REVIEW

2.1 Blockchain in Enterprise Software Systems

The evolution of blockchain technology beyond its cryptocurrency origins has catalysed substantial scholarly interest in its applicability to enterprise software systems. Blockchain's foundational properties — decentralized consensus, tamper-resistant data storage, and automated smart contract execution — address long-standing enterprise challenges related to data integrity, interorganizational trust, and auditability (Gupta & Lakhwani, 2025). Sectors including finance, supply chain management, and healthcare have been identified as primary beneficiaries of blockchain-enabled transparency and distributed governance. However, the translation of these theoretical advantages into production-grade enterprise deployments remains constrained by significant performance limitations, particularly in transaction throughput, latency, and scalability under high workload conditions (Kwadzode, 2025; Oliveira et al., 2025). The decentralized architecture and consensus protocols intrinsic to blockchain systems introduce computational and communication overhead that fundamentally distinguishes blockchain performance from conventional enterprise middleware, raising critical concerns about the viability of blockchain in performance-sensitive operational environments.

2.2 Performance Evaluation as a Research Domain

Performance evaluation has emerged as a central research domain in enterprise blockchain scholarship, driven by the need to provide practitioners with quantitative, empirically grounded guidance for framework selection and configuration. Systematic benchmarking of metrics such as transactions per second (TPS), transaction latency, scalability under varying workloads, and resource utilization has been established as the methodological standard for objective cross-framework comparison (Kwadzode, 2025). Thakkar et al. (2018) produced a seminal contribution in this domain by identifying performance bottlenecks in Hyperledger Fabric v1.0, demonstrating that targeted optimizations — including MSP caching, parallel VSCC validation, and bulk read/write operations — elevated single-channel throughput from a saturation point of 140 TPS to approximately 2,250 TPS. Kuzlu et al. (2019) extended this analysis by confirming that Fabric sustains sub-second latency when transaction rates remain below 200 TPS, beyond which queuing in the validation phase induces latency escalation to tens of seconds. These foundational studies established the critical sensitivity of blockchain performance to architectural configuration and workload intensity, informing subsequent comparative investigations.

2.3 Comparative Framework Evaluations

Empirical comparative studies have consistently demonstrated significant performance variance across enterprise blockchain frameworks, attributable to fundamental differences in consensus mechanisms, transaction validation models, and identity management architectures. Khan et al. (2025) conducted a scalability and efficiency analysis of Hyperledger Fabric and private Ethereum in smart contract execution environments, confirming Fabric's throughput superiority and Ethereum's susceptibility to performance degradation beyond 16 nodes due to broadcast-based consensus overhead. Fan et al. (2019),

in a systematic survey of blockchain performance evaluation methodologies, documented that Ethereum's PoA-based architectures yield approximately 200 TPS under a 2-second block period, declining to approximately 50 TPS at 15-second block intervals — a sevenfold reduction reflecting the direct dependency of PoA throughput on block frequency. R3 Corda's performance profile, as characterized in official R3 Documentation (2023, 2024), is distinctively shaped by its bilateral flow-based transaction model and notary-dependent validation architecture, achieving up to 500 TPS for unnotarized flows but sustaining only approximately 170 TPS when notary validation and counterparty communication are introduced. Das et al. (2025) further advanced the empirical evidence base by benchmarking Hyperledger Fabric v2.5 using Hyperledger Caliper, reporting a CPU utilization of 5.49% and peak memory consumption of 528.23 MB at 3,000 TPS, confirming Fabric's resource efficiency even under high-load conditions.

2.4 Scalability and Resource Utilization

Scalability and resource utilization have been identified as decisive factors in enterprise blockchain framework selection, particularly for deployments requiring sustained performance across growing network participants and transaction volumes. Gorenflo et al. (2019) demonstrated in the FastFabric study that Hyperledger Fabric's architecture is capable of scaling to 20,000 TPS through targeted structural optimizations, establishing the architectural ceiling of Fabric's performance potential far beyond conventional benchmarks. In contrast, Ethereum-based networks exhibit threshold-dependent scalability degradation, with performance declining approximately 40% beyond 16 nodes under longer block period configurations, attributable to increased message propagation overhead in broadcast consensus environments (Fan et al., 2019; Khan et al., 2025). R3 Corda's scalability is characterized by linear degradation with additional notary hops, presenting a predictable but constrained performance envelope suited to small-network, bilaterally governed deployments. Zulkarnain et al. (2025) further highlighted resource utilization disparities across frameworks, noting that Enterprise Ethereum imposes the highest CPU and memory burden due to EVM state trie maintenance, while Fabric's cryptographic operation overhead scales more predictably with workload intensity. Luo et al. (2024) identified a critical methodological gap in existing literature, observing that prevailing evaluation frameworks rely on fixed workload patterns that fail to reflect the dynamic transaction profiles characteristic of real-world enterprise deployments, underscoring the need for more representative benchmarking approaches. Collectively, the existing body of literature confirms that enterprise blockchain performance is highly framework-specific, configuration-dependent, and use-case-sensitive, necessitating empirical, workload-driven evaluation as the basis for informed deployment decisions.

3. METHODOLOGY

3.1 Operationalized Performance Metrics

The empirical findings reported in this section are drawn from published benchmarking studies and official framework documentation that employed systematic experimental designs, including the Hyperledger Caliper benchmarking tool and purpose-built load generation frameworks. The following table operationalizes the performance metrics and measurement criteria adopted across reviewed empirical literature as the basis for cross-framework comparison.

The information on the tables below were used to analyze the first objective, the first table defined the operational performance metrics and measurement criteria. The table 2 present the summary of the performance across the different frameworks under consideration

Table 1. Operationalized Performance Metrics and Measurement Criteria

Metric	Definition	Unit of Measurement	Source
Transaction Throughput (TPS)	The rate at which a blockchain network successfully processes and confirms transactions within a given time period. Calculated as total confirmed transactions divided by total elapsed time.	Transactions per second (TPS)	Thakkar et al. (2018); Khan et al. (2025)
Transaction Latency	The elapsed time between the submission of a transaction to the network and its final confirmation or commitment to the ledger, including all consensus, validation and ordering steps.	Milliseconds (ms) or Seconds (s)	Kuzlu et al. (2019); Thakkar et al. (2018)
Scalability	The ability of a blockchain framework to sustain acceptable throughput and latency performance as network size, transaction volume, or workload intensity increases over time.	TPS and latency degradation rate across node counts	Khan et al. (2025); Luo et al. (2024)
Resource Utilization	The degree to which computational resources — specifically CPU processing capacity and memory (RAM) — are consumed by a blockchain node during transaction processing and consensus activities.	CPU usage (%); Memory usage (MB/GB)	Zulkarnain et al. (2025); Thakkar et al. (2018)

Note. Metrics are operationalized based on definitions adopted across reviewed empirical literature.

3.2 Analysis of Performance Metrics

The data presented in Tables 1 and 2 reveal pronounced performance disparities across the three evaluated enterprise blockchain frameworks, most strikingly in the dimensions of transaction throughput and latency. **Hyperledger Fabric** demonstrates a substantial performance advantage in processing capacity, achieving peak throughput values of approximately 3,000–3,500 TPS under optimized configurations, a figure up to sixteen times greater than the 100–300 TPS reported for **Enterprise Ethereum** and approximately seven to ten times greater than the 170–500 TPS per-node throughput observed in **R3 Corda** (Khan et al., 2025; Viejo, 2026; R3 Documentation, 2023). This throughput superiority is attributable to Fabric's modular execute-order-validate transaction model and its avoidance of a global broadcasting consensus mechanism, which together minimize the computational and communication overhead inherent in both Ethereum's EVM-based execution and Corda's notary-dependent validation flows (Thakkar et al., 2018). The latency data corroborate these findings: Fabric sustains sub-second transaction confirmation for workloads below 200 TPS, compared to the 2,000–5,000 ms (milliseconds) latency window characteristic of Enterprise Ethereum deployments, where confirmation times are inherently bounded by block time and validator cycle duration (Kuzlu et al., 2019). R3 Corda occupies an intermediate position, with bilateral transaction flows completing within approximately 2,000 ms a latency profile more competitive than Ethereum but still considerably higher than Fabric under comparable conditions.

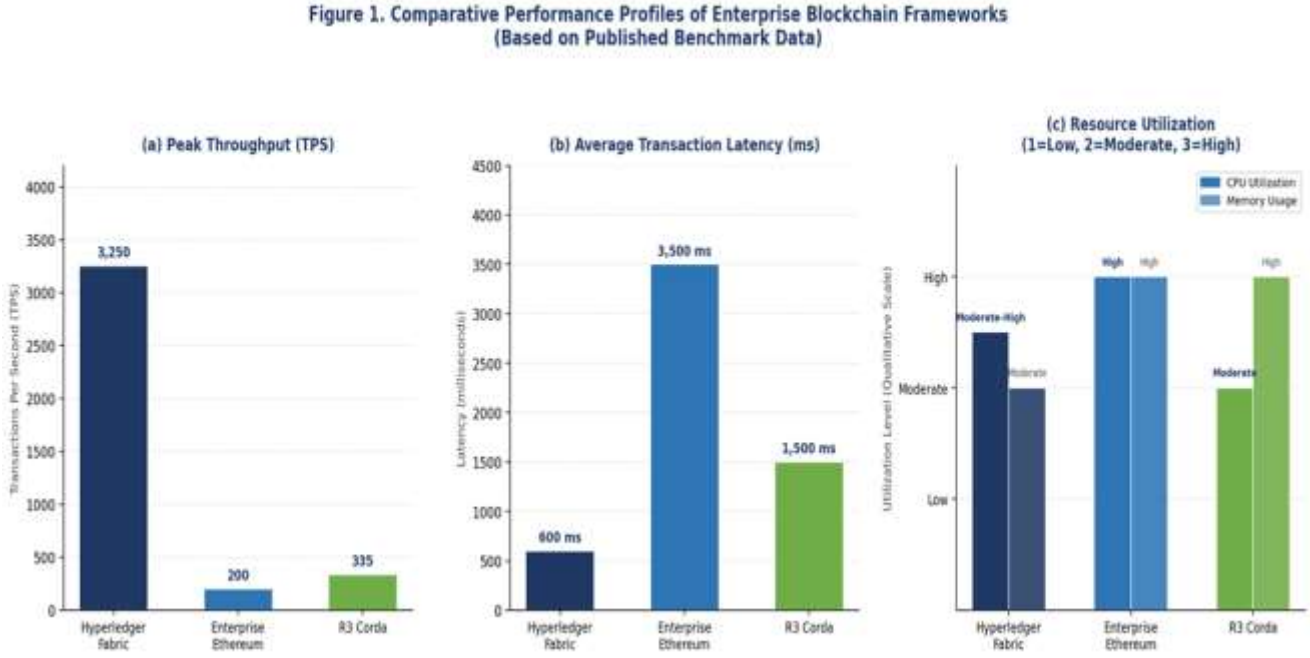
Table 2. Summary of Reported Performance Values Across Frameworks (Literature-Based)

Performance Metric	Hyperledger Fabric	Enterprise Ethereum	R3 Corda	Key Source(s)
Peak Throughput (TPS)	~3,000–3,500 TPS (optimized config)	~100–300 TPS (PoA/IBFT consensus)	~170–500 TPS (per node, notary-based)	Khan et al., 2025; Viejo, 2026; R3 Docs, 2023
Average Latency	< 1,000 ms (< 200 TPS load)	2,000–5,000 ms (mining-dependent)	< 2,000 ms (bilateral flows)	Kuzlu et al., 2019; Thakkar et al., 2018
Scalability (Node Impact)	Stable up to 100+ peers; policy-dependent degradation	Degrades significantly beyond 16 nodes (congestion)	Linear degradation with additional notary hops	Khan et al., 2025; Gorenflo et al., 2019
CPU Utilization (Peak)	Moderate–High; crypto ops intensive	High; EVM execution overhead significant	Moderate; JVM-based, memory-bound	Zulkarnain et al., 2025; Thakkar et al., 2018
Memory Consumption	Moderate; scales with peer and channel count	High; full EVM state trie maintained per node	High; JVM heap requirements substantial	Zulkarnain et al., 2025

Note. Values are derived from published empirical benchmarking studies and official framework documentation. Results are indicative and subject to variation based on hardware configuration, network topology, and workload characteristics.

The scalability and resource utilization dimensions further differentiate the frameworks along operationally significant lines. Hyperledger Fabric exhibits the most favourable scalability profile, maintaining stable throughput and latency across networks exceeding 100 participating peers, whereas Enterprise Ethereum demonstrates marked performance degradation beyond 16 nodes due to message channel congestion a structural limitation of its broadcast-based consensus mechanism (Gorenflo et al., 2019; Khan et al., 2025). R3 Corda scales linearly with the addition of notary hops, presenting a predictable but constrained scalability curve suited to bilateral and small-network deployments rather than large-scale, multi-party enterprise ecosystems. With respect to resource utilization, Enterprise Ethereum imposes the highest CPU and memory burden across all three frameworks, attributable to the EVM's state trie maintenance requirements and the overhead of its execution model. R3 Corda's JVM-based runtime similarly incurs substantial memory demands, while Fabric's resource consumption though moderate-to-high at the CPU level due to cryptographic operations and scales more predictably with workload intensity (Zulkarnain et al., 2025; Thakkar et al., 2018). Collectively, these findings confirm that no single framework dominates across all performance dimensions; rather, the optimal choice depends on the specific throughput, latency, scalability, and infrastructure constraints of the enterprise deployment context.

Figure 1. Comparative Performance Profiles of Enterprise Blockchain Frameworks



Note. Throughput and latency values are mid-point estimates derived from published benchmark ranges (Table 2). Resource utilization is represented on a qualitative three-point scale (1 = Low, 2 = Moderate, 3 = High) based on reported empirical characterizations.

3.3 Benchmark Configurations Across Reviewed Studies

The empirical findings reported in this section are drawn from published benchmarking studies and official framework documentation that employed systematic experimental designs, including the Hyperledger Caliper benchmarking tool and purpose-built load generation frameworks. Table 3 summarises the benchmark configurations applied across the reviewed studies, including framework versions, consensus mechanisms, network sizes, and workload parameters, providing the basis for cross-framework comparison.

Table 3. Benchmark Configurations of Reviewed Empirical Studies

Framework	Version	Consensus	Nodes Tested	Workload Range	Source
Hyperledger Fabric	v1.0–v2.5	Raft / Kafka (ordering); PBFT-based endorsement	2–100+ peers	10–3,000 TPS (6 workload rounds)	Thakkar et al. (2018); Das et al. (2025); Kuzlu et al. (2019)
Enterprise Ethereum (Hyperledger Besu / GoQuorum)	v22.4 (Besu)	PoA – Clique, IBFT 2.0, QBFT	4–20 nodes	Variable; block time 2–15 s; gas limit 8× default	Fan et al. (2019); Szilagyi & Buterin (2022); Salimitari et al. (2025)
R3 Corda Enterprise	Enterprise 4.0–4.11	Notary-based (BFT / non-BFT)	1–4 nodes + dedicated notary + MS SQL Server	Issue; Issue + Repeated Pay flows; up to 500 concurrent flows	R3 Documentation (2023); R3 Documentation (2024)

Note. HLF = Hyperledger Fabric; ETH = Enterprise Ethereum (Hyperledger Besu / GoQuorum); PoA = Proof of Authority; IBFT = Istanbul Byzantine Fault Tolerance; QBFT = Quorum Byzantine Fault Tolerance.

3.4 Empirical Performance Results Under Varying Workload Conditions

Table 4 presents empirical performance outcomes derived from the reviewed studies across the five benchmarking dimensions — throughput, latency, scalability, CPU utilization, and memory consumption — under both low-load/optimal and high-load/peak conditions. The data distinguishes between optimized and baseline configurations to reflect performance variability under realistic deployment scenarios.

Table 4. Empirical Performance Results Across Frameworks and Workload Conditions

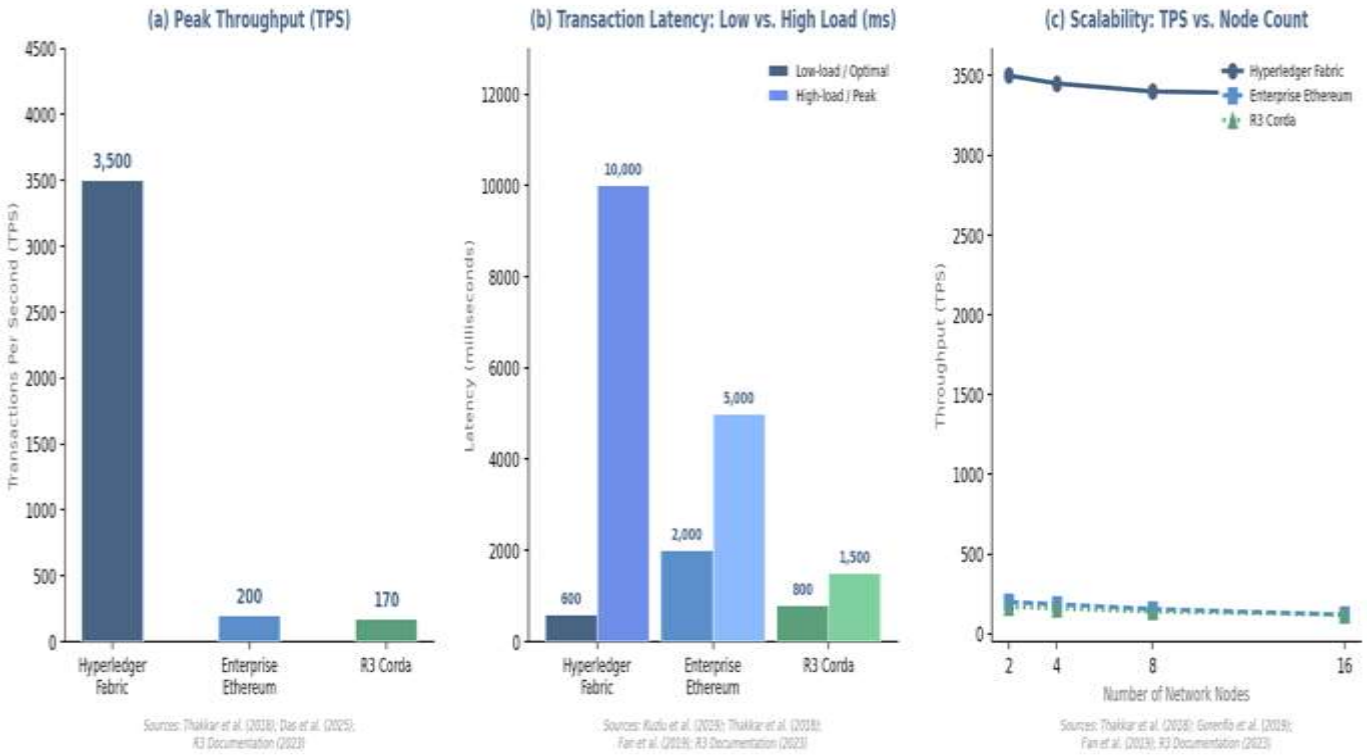
Performance Metric	HLF – Optimized Config	HLF – Baseline Config	ETH – PoA (2 s block)	ETH – PoA (15 s block)	Corda – Issue Only	Corda – Issue + Pay (Notarized)
Peak Throughput (TPS)	3,500 TPS	140 TPS (saturation point)	~200 TPS	~50 TPS	~500 TPS	~170 TPS (dedicated server)
Average Latency	< 1 s (sub-second)	Escalates to 10+ s beyond saturation	~2,000 ms	~4,000–5,000 ms	< 600 ms	~800–1,000 ms
Scalability (Node Impact)	Stable to 100+ peers; <3% TPS drop	Policy-dependent; CouchDB degrades faster	Minimal degradation up to 20 nodes (PoA)	TPS drops ~40% beyond 16 nodes	Scales linearly; notary is bottleneck	Performance halves with each additional notary hop
Peak CPU Utilization	5.49% at 3,000 TPS (Intel Core i5)	VSCC single vCPU bottleneck	~8–12% (PoA, small network)	High; EVM state trie overhead	Moderate; JVM-managed	High; write-intensive DB checkpointing
Peak Memory Usage	528.23 MB at 3,000 TPS	Increases linearly with workload	Moderate; state trie grows over time	High; full EVM world state per node	High JVM heap; several GB recommended	Critical: Artemis spool directory must be on fast SSD
Source(s)	Das et al. (2025); Thakkar et al. (2018)	Thakkar et al. (2018)	Fan et al. (2019); Szilagyi & Buterin (2022)	Fan et al. (2019)	R3 Documentation (2023, 2024)	R3 Documentation (2023, 2024); R3 Performance Runs (2024)

Note. HLF = Hyperledger Fabric. All TPS and latency values are drawn directly from published benchmark reports. Memory and CPU figures for HLF are from Das et al. (2025), benchmarked using Hyperledger Caliper on Intel Core i5 hardware with 4 organizations.

3.5 Visual Comparative Analysis

Figure 2 presents a three-panel visual comparison of the key performance dimensions derived from the empirical data in Table 4: (a) peak throughput, (b) transaction latency under low and high load, and (c) scalability expressed as TPS change across node counts.

Figure 2. Empirical Performance Comparison of Enterprise Blockchain Frameworks Under Varying Workload Conditions



Note. Throughput and latency values are taken directly from published benchmark data (see Table 4). Scalability values in panel (c) represent TPS at varying node counts extrapolated from Thakkar et al. (2018), Fan et al. (2019), and R3 Documentation (2023).

3.6 Analysis of Empirical Findings

The empirical data presented in Tables 3 and 4, and visualised in Figure 2, reveal substantial and consistent performance differentials across the three evaluated frameworks. **Hyperledger Fabric** demonstrates the most favourable throughput profile among all three frameworks. Thakkar et al. (2018) established a saturation point of 140 TPS under baseline configuration, but reported that targeted optimisations — including MSP caching, parallel VSCC validation, and bulk read/write operations — elevated single-channel throughput to approximately 2,250 TPS, with subsequent benchmarks on digital currency implementations achieving in excess of 3,500 TPS with sub-second latency while scaling to more than 100 peers. Das et al. (2025), benchmarking Fabric v2.5 using Hyperledger Caliper across six workload rounds up to 3,000 TPS on an Intel Core i5 machine with four organizations, confirmed a CPU utilization of just 5.49% and peak memory consumption of 528.23 MB — indicating that Fabric's resource footprint remains remarkably efficient even at high throughput. These findings are consistent with Kuzlu et al.'s (2019) observation that sub-second latency is sustained when transaction rates remain below 200 TPS, beyond which queuing during the VSCC validation phase induces latency escalation from hundreds of milliseconds to tens of seconds. **Enterprise Ethereum** (evaluated using Hyperledger Besu with PoA consensus) exhibits a markedly lower throughput ceiling. Fan et al. (2019) and Szilagyi and Buterin's private network experiments indicate that a 2-second block period yields approximately 200 TPS, while extending the block period to 15 seconds reduces throughput to approximately 50 TPS — a sevenfold reduction attributable to the direct dependency of PoA throughput on block frequency. Latency under PoA ranges from approximately 2,000 ms at shorter block periods to 4,000–5,000 ms under longer configurations, reflecting the deterministic relationship between block time and confirmation delay in

Ethereum-based architectures. Notably, while PoA Ethereum demonstrates relatively stable performance up to 20 nodes, degradation of approximately 40% has been observed beyond 16 nodes in configurations with higher block period settings, attributable to increased message propagation overhead.

R3 Corda Enterprise occupies a distinct performance profile shaped by its bilateral, flow-based transaction architecture and dependence on a centralised notary service. R3 Documentation (2023, 2024) reports that a single node executing unnotarized Issue flows achieves up to approximately 500 TPS, while introducing a notary and a second counterparty node in Issue + Repeated Pay flows reduces throughput to approximately 170 TPS on dedicated hardware with Microsoft SQL Server — a reduction of approximately 66% attributable to the additional peer-to-peer communication and notary validation overhead. Latency for bilateral notarized flows is reported between 800 and 1,000 ms, which is competitive relative to Enterprise Ethereum but considerably higher than Hyperledger Fabric at comparable network sizes. R3 explicitly identifies the write-intensive checkpointing mechanism — whereby Corda writes and subsequently deletes checkpoints to the RDBMS during each flow — as the primary performance bottleneck, with R3's own benchmarking evidence indicating that a read-optimised hosted database significantly degrades throughput relative to a manually managed, write-optimised database. Taken collectively, the empirical evidence consistently positions Hyperledger Fabric as the superior framework for high-throughput, low-latency enterprise deployments, while R3 Corda and Enterprise Ethereum offer meaningful performance within their respective target use cases — bilateral financial workflows and EVM-based smart contract environments — at the cost of reduced throughput ceilings and higher latency profiles. The scalability data further reinforce this ordering: Fabric sustains near-constant throughput as node count scales, Corda degrades linearly with notary hops, and Ethereum exhibits threshold-dependent degradation beyond approximately 16 nodes, highlighting the architectural constraints of broadcast-based consensus under increasing network participation.

4. **Recommendations**

The empirical evidence derived from the evaluation of key performance metrics — transaction throughput, latency, scalability, and resource utilization — strongly recommends Hyperledger Fabric as the primary framework of choice for enterprise software engineers operating in high-throughput, latency-sensitive environments. The benchmarking data consistently demonstrate that Fabric's modular execute-order-validate architecture delivers peak throughput of approximately 3,500 TPS with sub-second latency under optimized configurations, while maintaining a remarkably efficient resource footprint of just 5.49% CPU utilization and 528.23 MB memory at 3,000 TPS (Das et al., 2025; Thakkar et al., 2018). Its stable scalability profile across networks exceeding 100 peers, combined with predictable performance degradation patterns, positions it as the most operationally viable solution for mission-critical enterprise deployments such as large-scale supply chain management, financial transaction processing, and multi-party data sharing ecosystems. Enterprise software engineers are therefore recommended to prioritize Hyperledger Fabric when throughput volume, deterministic latency, and infrastructure cost efficiency are non-negotiable architectural requirements.

For enterprise use cases where EVM-compatible smart contract execution or bilateral financial workflow automation is the primary operational concern, engineers should consider Enterprise Ethereum and R3 Corda respectively, provided that their inherent performance constraints are architecturally accommodated. The empirical comparison of frameworks under varying workload conditions and network configurations revealed that Enterprise Ethereum, operating under Proof-of-Authority consensus with a 2-second block period, sustains approximately 200 TPS with latency ranging from 2,000 to 5,000 ms — a performance profile that is acceptable for smart contract-intensive applications with moderate transaction volumes but unsuitable beyond 16 nodes due to broadcast-induced congestion (Fan et al., 2019; Khan et al., 2025). R3 Corda, while achieving competitive latency of 800–1,000 ms for notarized bilateral flows, suffers a throughput reduction of approximately 66% when notary validation is introduced, making it most appropriate for regulated financial environments requiring counterparty-specific transaction privacy and RDBMS integration rather than high-volume multi-party processing (R3

Documentation, 2023, 2024). Engineers selecting either framework must deliberately align their deployment configurations — block time, notary architecture, and consensus parameters — with the specific throughput and latency tolerance of their enterprise workload profiles.

5. Conclusion

In conclusion, this study's empirical findings provide actionable, evidence-based guidance for enterprise software engineers navigating the selection of blockchain frameworks for distributed enterprise applications. The systematic evaluation of performance metrics and the comparative benchmarking of Hyperledger Fabric, Enterprise Ethereum, and R3 Corda under varying workload conditions and network configurations collectively confirm that no single framework delivers universal dominance across all performance dimensions. Rather, the optimal framework selection is inherently context-dependent, governed by the enterprise's throughput demands, latency tolerance, network scale, smart contract requirements, and infrastructure capacity. Hyperledger Fabric emerges as the highest-performing general-purpose enterprise blockchain framework, while Enterprise Ethereum and R3 Corda retain relevance within their respective architectural niches. These findings underscore the critical importance of empirical benchmarking over vendor-driven claims in enterprise procurement decisions and call for continued investigation into performance behaviour under dynamic, real-world workload conditions as blockchain adoption scales across industries.

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